Çankaya University
Department of Computer Engineering
2014 - 2015 Spring Semester

CENG 290 - Data Communications

First Midterm Examination

1) Fill in the blanks with appropriate terms from the list:

1. We want to send a sequence of computer screen images over an optical fiber. The screen is 480×640 pixels, each pixel being 24 bits. There are 60 screen images per second. Therefore we need a bandwidth of 442 ____________________

2. ____________________ satellites permanently remain above the same spot on Earth.

3. The ____________________ is the distance between two routers divided by the propagation speed.

4. The ____________________ largely depends on the rate at which traffic arrives at the queue and the transmission rate of the link.

5. The ____________________ concerns with transmitting raw bits over a communication channel.

6. If the intensity of a signal is reduced to 1/1000 of its previous value, we say it reduced by ____________________ dB.

7. The main task of the ____________________ is to transform a raw transmission facility into a line free of transmission errors.

8. In ____________________ networks, the resources needed along a path (buffers, link bandwidth) are reserved for the duration of communication session.

9. Telephones are ____________________ systems because both parties on the phone can talk and listen at the same time.

10. ____________________ is sending multiple signals or streams of information on a carrier at the same time in the form of a single, complex signal and then recovering the separate signals at the receiving end.

11. The most natural example of ________________ is radio and television broadcasting, in which multiple radio signals at different frequencies pass through the air at the same time.

12. Telephone system of a neighborhood use ________________ topology.

13. If you are moving as you use your cell phone, you may be transferred to another base station. This is called ________________

14. Garage door openers, radio controlled toys etc. use ________________ bands

15. The ratio of signal power to noise power is called ________________ .

half duplex, network layer, transmission delay, low - altitude, circuit switched, physical layer, time division multiplexing, star, bus, geostationary, full duplex, packet switched, propagation delay,queuing delay, data link layer, multiplexing, bandwidth, frequency-division multiplexing, 30, 100, 300, 1000, handoff, ISM(Industrial, Scientific, Medical), SNR, Mbps, kbps, Gbps.

2) Consider sending a large file of F bits from Host 1 to Host 2. There are two links and one node between 1 and 2. Neglect propagation delays and queueing delays. Host 1 segments the file into segments of S bits and adds h bits of header to each segment. Assume F/S is an integer. Each link has a transmission rate of R bps. Find the end-to-end delay in sending the file.

3) Using CDMA encoding, users A, B, C, D each send a 2-bit message. Their codewords are:

$$Q_A = (1\ 1\ 1\ 1), \qquad Q_B = (1\ 1\ -1\ -1), \qquad Q_C = (1\ -1\ 1\ -1), \qquad Q_D = (1\ -1\ -1\ 1)$$

and the combined signal is: $(4\ 0\ 0\ 0\ -2\ 2\ -2\ -2)$

Decode their messages.

4) For the following set of codewords

$$(0\,0\,0\,0\,0\,0\,0), \qquad (0\,0\,0\,1\,1\,1\,1), \qquad (0\,1\,1\,0\,0\,1\,1), \qquad (1\,0\,1\,0\,1\,0\,1)$$

a) Find the minimum Hamming distance.

b) What is the maximum number of errors we can detect?

c) What is the maximum number of errors we can correct?

5) A message 10110101 is transmitted using the CRC polynomial method. The generator polynomial is $x^3 + 1$.

a) What is the actual frame transmitted?

b) How many bits must be damaged for an error to be unrecognized?

6) A transmitted message is corrupted with probability p. We use error detection and retransmission. (Assume errors are always detected) What is the probability we need exactly two retransmissions?

Answers

1)

1. Mbps
2. geostationary
3. propagation delay
4. queuing delay
5. physical layer
6. 30
7. data link layer
8. circuit switched
9. full duplex
10. multiplexing
11. frequency-division multiplexing
12. star
13. handoff
14. ISM(Industrial, Scientific, Medical)
15. SNR

2) $\frac{F}{S}\frac{S+h}{R} + \frac{S+h}{R}$

3)

A) $(1\ 1\ 1\ 1) \cdot (4\ 0\ 0\ 0) = 4, \qquad (1\ 1\ 1\ 1) \cdot (-2\ 2\ -2\ -2) = -4$
$\Rightarrow$ message: 10

B) $(1\ 1\ -1\ -1) \cdot (4\ 0\ 0\ 0) = 4, \qquad (1\ 1\ -1\ -1) \cdot (-2\ 2\ -2\ -2) = 4$
$\Rightarrow$ message: 11

C) $(1\ -1\ 1\ -1) \cdot (4\ 0\ 0\ 0) = 4, \qquad (1\ -1\ 1\ -1) \cdot (-2\ 2\ -2\ -2) = -4$
$\Rightarrow$ message: 10

D) $(1\ -1\ -1\ 1) \cdot (4\ 0\ 0\ 0) = 4, \qquad (1\ -1\ -1\ 1) \cdot (-2\ 2\ -2\ -2) = -4$
$\Rightarrow$ message: 10

4) a) $d_{min} = 4$

b) $4 - 1 = 3$ errors can be detected

c) $(4 - 1)/2 = 1.5 \quad \Rightarrow \quad$ 1 errors can be corrected

5) a) The message 10110101 is $x^7 + x^5 + x^4 + x^2 + 1$ in polynomial representation. Degree of generator is 3, so multiply this polynomial by x^3 to obtain

$$x^{10} + x^8 + x^7 + x^5 + x^3$$

Now divide this by $x^3 + 1$. The result is $x^7 + x^5 + 1$, the remainder is 1. Therefore the transmitted message is:

$$x^{10} + x^8 + x^7 + x^5 + x^3 + 1$$

or, equivalently:

10110101001

b) The error must be equivalent to the generating polynomial. So we need a 4-bit burst error, with the first and last bits damaged.

6) First, corrupted. Second, corrupted. Third, arrives safely.

$$\Rightarrow \quad p^2(1 - p)$$